The use of combined heat and power in community heating schemes

Four case studies

- Economic benefits for local authorities and tenants
- Combined heat and power units installed with capital costs recouped in three to five years
- Improved comfort levels for tenants
- Significant reductions in carbon dioxide emissions

ENERGY EFFICIENCY

BEST PRACTICE PROGRAMME

GOOD PRACTICE CASE STUDY 370

INTRODUCTION

Modern community heating systems are a reliable, easy to maintain and efficient way of heating blocks of flats, social housing and groups of buildings. The advantages (when compared to using individual boilers) are that community heating:

- provides low-cost heating and hot water for tenants
- uses fuel more efficiently
- reduces carbon dioxide (CO_2) emissions.

Community heating systems are highly efficient in the use of fuel. By using combined heat and power (CHP) in a community heating system its efficiency can be increased still further, with the following benefits:

- cheap electricity
- income for landlords from the sale of electricity
- even lower CO_2 emissions.

Community heating supplied by a CHP system is therefore an excellent way to:

- control and reduce costs
- improve standards of comfort for tenants
- reduce environmental impact and energy use.

This document is intended for local authority housing and housing association managers who are considering installing, refurbishing or increasing the efficiency of a community heating system. It describes the advantages of using CHP to provide community heating and discusses how it can be installed and financed. The case studies profile four local authorities' use of community heating with CHP to provide heat and power in a variety of circumstances.

WHAT IS COMMUNITY HEATING?

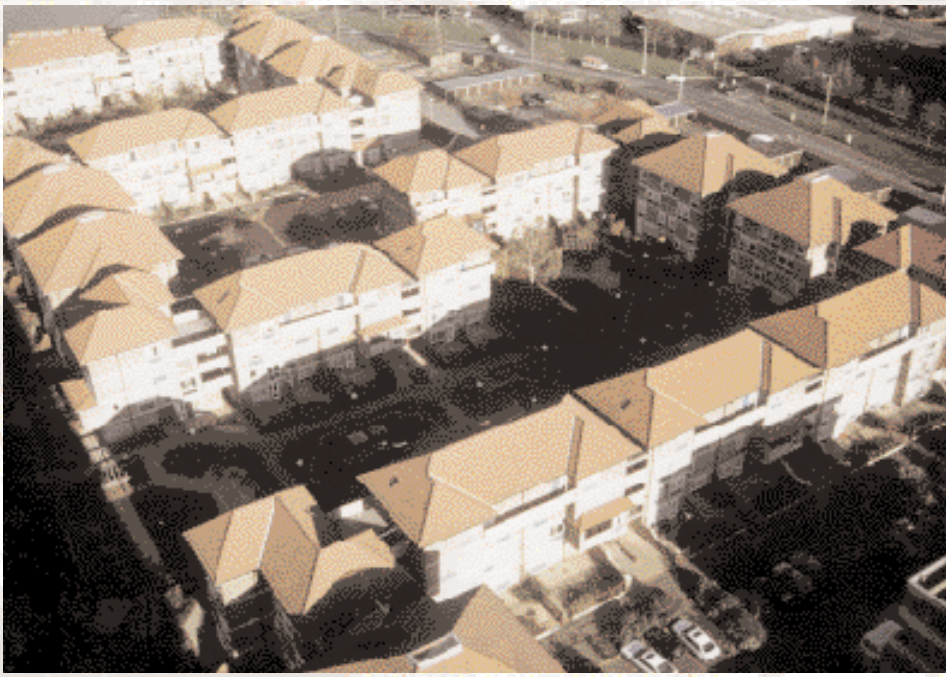
A community heating system uses a central boiler to heat a number of buildings or dwellings. It can serve both domestic and business sectors. Schemes can range in size from those serving a single block of flats to those serving whole neighbourhoods.

The boiler plant generates hot water and is usually fuelled by gas, but it can also use oil, coal, waste, or a combination of these. The hot water is circulated through pipes to buildings on the scheme. In some systems the hot water then passes through the radiators in the dwelling, in others heat exchangers take heat from the mains for use in each dwelling. Apart from the absence of a boiler, there is no difference for the occupants between a building using community heating and one with conventional central heating.

Community heating is one of the most cost-effective and environmentally friendly ways of providing heat. Its greater fuel efficiency means that emissions of CO_2 can be vastly reduced, thus helping local authorities meet their commitments under Local Agenda 21 (LA21) and the Home Energy Conservation Act (HECA). Fuel costs can be up to 40% lower than for other heating systems. There are two reasons for this: the boiler can work at optimum efficiency for more of the time; and, because the boiler has a large load, fuel can be purchased more competitively.

Cheaper fuel means that tenants can afford to keep their dwellings warm and, because buildings are heated properly, the risk of damage from condensation and mould is reduced. Tenants are generally very satisfied, thereby reducing complaints, voids and management costs.

At Giles Close, Birmingham, average internal temperatures increased by 5˚C, improving occupant comfort. Annual fuel savings were £134 for each dwelling, and CO_2 emissions were cut by the equivalent of over 27 tonnes of carbon each year (see page 9).



Maintenance costs are also lower than for conventional heating schemes because there is only one boiler to maintain, rather than a large number of boilers situated in many properties.

BENEFITS OF COMMUNITY HEATING

For landlords:

- lower maintenance costs
- lower fuel costs
- lower CO_2 emissions
- happier tenants
- fewer voids
- competitive fuel purchasing
- the opportunity to use CHP.

For tenants:

- cheaper heat and hot water
- reduced condensation and mould
- improved levels of comfort.

For the environment:

- reductions in CO_2 emissions
- reduced usage of fossil fuels.

WHAT IS COMBINED HEAT AND POWER?

CHP systems produce both heat and electricity from a single plant. This makes them far more efficient than most power stations, which are not designed to make use of the surplus heat they produce when generating electricity. Instead, this heat is exhausted into the environment. CHP systems use the 'waste' heat they produce to provide hot water for central heating systems and other purposes, as well as producing electricity for local use. Power stations are generally about 35% efficient, while a CHP system is, on average, 85% efficient.

BENEFITS OF COMBINED HEAT AND POWER

For landlords:

- lower fuel usage
- it can be installed without capital cost
- electricity to use or sell
- a secure power supply.

For tenants:

- cheap heat, hot water and power.

For the environment:

- reductions in CO_2 emissions
- even greater reductions in the use of fossil fuels than with community heating alone.

The high efficiency of CHP systems also results in major environmental benefits, including significant reductions in the use of fossil fuels, thereby helping to conserve the world's finite energy resources. There are also reductions in CO_2 emissions, a contribution to climate change, factors of which are the greenhouse effect and global warming.

In addition to the environmental benefits of CHP, local authorities also benefit from the opportunity to obtain cheaper electricity, which can be sold to tenants, used to service the common parts of buildings, or exported through the grid, thus producing income for the local authority. There is increased security of power supply as the CHP can supply power should the grid fail (and vice versa).

CHP can be installed with no capital costs to the local authority, through third-party energy supply agreements.

Leicester City Council has saved £48 000 annually following the installation of CHP at St Andrews. At the same time, CO_2 emissions have been cut by the equivalent of over 55 tonnes of carbon each year (see page 8).

WHEN TO USE COMBINED HEAT AND POWER FOR COMMUNITY HEATING

CHP should always be considered when:

- a community heating scheme is planned
- refurbishment of existing community heating is undertaken
- installing new boiler plant
- replacing or refurbishing existing plant
- reviewing electricity supply or standby electrical generation capacity or plant
- considering energy efficiency strategy in general.

Community heating should be considered when refurbishing heating systems in blocks of flats or sheltered housing. The refurbishment of old-fashioned community heating schemes can often be more cost-effective than replacing them with individual systems.

When considering CHP the key criteria are the demands for heat and power. To be economically viable the CHP system normally needs to run for at least 4000 hours per year. Points to consider are:

- the base loads for the system, such as heating, domestic hot water (DHW) and power for common areas, lifts and heating pumps
- whether there are other local heat or power loads that could be connected to the community heating scheme to use the output during the day when the demand from housing is low.

Funds for community heating and CHP can come from three sources.

- The local authority's own funds.
- Equipment supplier finance (ESF) – most equipment suppliers will provide finance for the purchase of CHP, allowing the payments to be phased over several years, and so financed from the savings.
- Discounted energy purchase – the CHP supplier installs and operates the plant and sells the heat and power produced to the authority at an agreed price per unit. With this purchase method there are no capital costs. This is the scheme used by Birmingham City Council at Giles Close Flats.

Grant scheme initiatives may be available for suitable projects. Current information on grants may be obtained from the Combined Heat and Power Association (CHPA) (see Further Information on page 10).

PRIVATE FINANCE INITIATIVE

CHP schemes can be financed under the Private Finance Initiative (PFI). Assistance, support and advice on setting up a PFI scheme can be obtained from The Public/Private Partnerships Programme, 35 Great Smith Street, Westminster, London SW1P 3BJ. Tel 0171 664 3145. Fax 0171 664 3030.

One reason the scheme at Cruddas Park is so successful is because the high daytime load of the shopping centre complements the housing demand in the early mornings and evenings (see page 7).

When the London Borough of Newham refurbished College Point it considered decentralisation, but the feasibility study showed that community heating with CHP was more cost-effective (see page 6).

CASE STUDY 1 – COLLEGE POINT, LONDON BOROUGH OF NEWHAM

BACKGROUND

College Point is a 1960s high-rise building containing 123 flats. In the early 1990s, it was due for major refurbishment and the heating system was a priority area. The flats were heated by the original community heating system and maintenance was expensive, the boiler was oil-fired and situated on the roof, and the heating provided to tenants was partial and switched on seasonally.

The London Borough of Newham was attracted by the financial and environmental benefits of CHP used with community heating, but it also considered installing individual gas-fired central heating in each flat. Before making a decision, it commissioned a feasibility study on using CHP for College Point. The feasibility study showed that using community heating with a CHP plant was the best option; that the plant would have financial and environmental benefits; and that it would have a predicted payback period under five years.

IMPLEMENTATION

The scheme was funded jointly by the Council and the Government's Green House Programme (no longer running). The CHP plant was installed together with two new boilers in a purpose-built boiler house situated close to College Point. It is used to preheat water before it passes back to the main boiler plant. The CHP plant provides heating via radiators and serves DHW cylinders in each flat.

The CHP plant provides the landlord with electricity for lighting in communal areas, for lifts and for the boiler house. Surplus electricity is sold to the regional electricity company (REC), London Electricity.

RESULTS

The scheme has been very successful.

- Tenants have full central heating and hot water available whenever they require it.
- The CHP plant provides power for the landlord to use and sell.
- Income is generated from selling surplus electricity to the REC.
- Energy savings of 3.2 GJ and reductions in CO_2 emissions equivalent to 90 tonnes of carbon per year have been achieved.
- The payback period will be less than five years.

DATA TABLE

Capital cost	**£50 160**
Annual maintenance costs	**£2364**
Annual fuel saving	**£5808**
Annual electricity sales	**£7200**
Net annual savings	**£10 644**
Payback	**4.7 years**
Carbon saving per year	**90 tonnes**

CASE STUDY 2 – CRUDDAS PARK, NEWCASTLE UPON TYNE

BACKGROUND

The Cruddas Park complex comprises a 1967 20-storey high-rise block with 159 flats, a shopping mall with an underground car park, a social services care home and a housing department office. The original heating system was inefficient and the boilers were oversized.

In 1993, the block of flats was due for major refurbishment. Newcastle City Council was interested in incorporating a CHP plant into the central boiler facility during this refurbishment because it believed the financial benefits could be passed on to the tenants as affordable warmth. A feasibility study indicated that it would be of greater benefit to provide heat and electricity to other buildings in the complex, as this would enable the CHP system to run at full potential for longer periods.

IMPLEMENTATION

The scheme was financed under the Government's Green House Programme (no longer running).

The CHP plant was installed in series with the three existing boilers. These were fired by refuse-derived fuel (RDF), coal and oil respectively, although normally only the RDF boiler operates.

The CHP plant provides heating and hot water services to all the flats, the shops and the communal laundry. It provides electricity for lighting and lifts in the communal areas of the high-rise block of flats, for the shopping mall and the basement car park, and for the plant room. No electricity is exported.

RESULTS

The Cruddas Park community heating and CHP scheme is successful, largely because it is used to provide heat and electricity for two types of building, each with high demands at different times of the day. The shopping mall has a high demand during the working day, whereas the flats require most heat and electricity at either side of this period. This means that the system runs to its full potential for longer periods, thereby maximising its efficiency.

The use of the city's waste as fuel has the additional benefits of reducing the need for landfill sites, the costs associated with landfilling and cutting the use of fossil fuels.

Overall, the scheme has:

- reduced the cost of providing heat and hot water for Council tenants. This saves the Council money as all tenants in the city pay a flat rate for heat
- provided cheap power for communal areas of the flats and for the shopping mall, the car park and the laundry
- reduced the need for landfill sites
- reduced the use of fossil fuels
- reduced CO_2 emissions, equivalent to 100 tonnes of carbon each year.

The investment in the CHP scheme is expected to be recovered in just over five years.

DATA TABLE

Capital cost	**£86 000**
Annual maintenance costs	**£4295**
Calculated annual fuel saving	**£21 266**
Calculated net annual savings	**£16 971**
Payback	**5.1 years**
Estimated carbon saving per year	**100 tonnes**

CASE STUDY 3 – ST ANDREWS, LEICESTER

BACKGROUND

St Andrews is made up of several four-storey blocks of flats and maisonettes in the centre of Leicester. It consists of 240 dwellings and a care home.

In 1991, Leicester City Council replaced St Andrews' 20-year-old coal-fired boiler plant and converted to natural gas-fired plant. At the same time the council asked Lincoln Green Energy to undertake a feasibility study to ascertain whether CHP was a viable option.

Following the study, the Council decided to go ahead with the installation of CHP, and the work was completed in 1994.

IMPLEMENTATION

The scheme was partly funded under the Energy Saving Trust's (EST's) residential CHP pilot programme.

The CHP plant was installed in series with a new gas-fired boiler. It preheats a quantity of the return water before passing it back to the main boiler plant. The central boiler plant provides heating through the winter via the building's original radiators, and serves DHW cylinders in all of the flats throughout the year.

The CHP plant provides the landlord with electricity at St Andrews for lighting in communal areas, lifts and the plant room pumps. Electricity is also exported across the grid to two local authority leisure centres. The Council now plans also to sell the electricity to tenants.

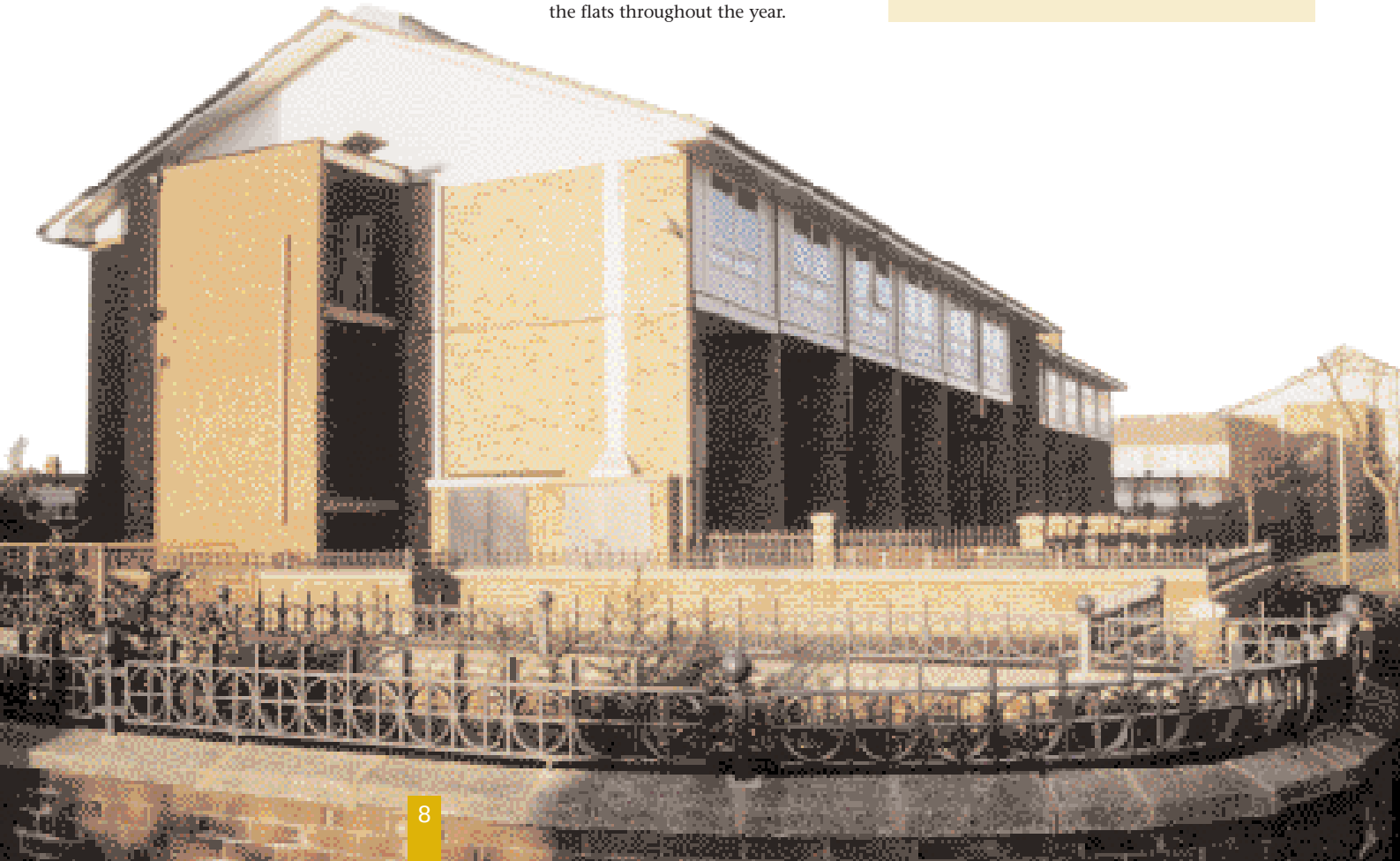
RESULTS

This scheme is very successful. By integrating the community heating scheme with the supply of electricity to the two leisure centres, longer running hours have been achieved for the CHP plant. This has helped to increase savings and reduce the payback period.

It has saved nearly £48 000 per year for the Council. The system achieved a payback period of just over three years.

DATA TABLE

Capital cost	**£128 290**
Annual maintenance costs	**£10 053**
Annual fuel saving	**£47 986**
Net annual savings	**£37 933**
Payback	**3.4 years**
Estimated carbon saving per year	**55 tonnes**



CASE STUDY 4 – GILES CLOSE FLATS, BIRMINGHAM

BACKGROUND

Giles Close Flats, three blocks of 48 flats built in the 1960s, were refurbished in the early 1990s. The original heating for the flats was an off-peak electric under-floor system and the flats were cold, expensive to heat and suffered from condensation and mould. Birmingham City Council chose to replace this system with community heating, which utilised CHP.

The Council already used CHP at a leisure centre near to Giles Close. The plant provided heat and power to the centre and the Council was very pleased with the way it functioned. Associated Heat Services (AHS) (now Dalkia Utilities Services plc), a private contractor, owned and operated the plant and this reduced the Council's maintenance costs. Moreover, AHS provided heat and electricity at very competitive prices. The Council therefore decided to install community heating at Giles Close and to extend the CHP plant to serve the flats.

IMPLEMENTATION

Because the Council would buy more heat from them, AHS paid for the extension of the pipework from the leisure centre CHP plant to the flats, and for an additional boiler house to provide top-up heat.

The Council installed distribution pipework in the flats, radiators, heat meters and token payment systems, and a heat exchanger in each tower block. The Government's Green House Programme (no longer running) funded part of this work.

RESULTS

The use of community heating with the leisure centre CHP has been very successful. The benefits include the following.

- Tenants can now heat their flats to a comfortable level and always have hot water available. The average temperature in the flats has increased from 13˚C to 18˚C.
- Heating costs have been cut, saving tenants £46 per year.
- There are fewer voids and transfer applications.
- Maintenance costs have been reduced.
- The local authority gains income of £88 per dwelling annually from the charges for fuel. This contributes to the refurbishment and maintenance costs of the dwellings.
- The environment has benefited from an annual reduction in CO_2 emissions, equivalent to 30 tonnes of carbon.

DATA TABLE

CHP capital cost	**Nil**
CHP maintenance costs	**Nil**
Heating system installation cost	**£602 000**
Tenants' total annual fuel saving	**£6624**
Council's annual income from fuel sales	**£12 672**
Payback	**Not applicable**
Carbon saving per year	**30 tonnes**

FURTHER INFORMATION

CONTACTS FOR RELATED INFORMATION OR SERVICES

Combined Heat and Power Association

Grosvenor Gardens House, 35-37 Grosvenor Gardens, London SW1W 0BS.
Tel 0171 828 4077. Fax 0171 828 0310

Energy Saving Trust

21 Dartmouth Street, London SW1H 9BP.
Tel 0171 222 0101. Fax 0171 654 2444

DETR ENERGY EFFICIENCY BEST PRACTICE PROGRAMME PUBLICATIONS

The following Best Practice programme publications are available from BRECSU Enquiries Bureau. Contact details are given on the back cover.

General Information Reports

23 District heating and cooling: an IEA implementing agreement
50 Unlocking the potential – financing energy efficiency in private housing
51 Taking stock – private financing of energy efficiency in social housing

Good Practice Case Studies

80 Rejuvenation of community heating – pipework refurbishment in Manchester
81 Community heating in Sheffield
82 Consumer connection to community heating in Sheffield
121 Energy efficient refurbishment of high rise large panel system housing – five case studies
312 Community heating in Nottingham: an overview of a rejuvenated system
313 Community heating in Nottingham: domestic refurbishment
314 Community heating in Nottingham: pipework refurbishment

Good Practice Guides

176 Small-scale combined heat and power for buildings
182 Heating system option appraisal – a manager's guide
187 Heating system option appraisal – an engineer's guide for existing buildings
234 Guide to community heating and CHP. Commercial, public and domestic applications
240 Community heating – a guide for housing professionals (to be published by BRECSU)
267 Combined heat and power in hospitals (to be published by BRECSU)

New Practice Final Profile

39 Combined heat and power for community heating

The Department of the Environment, Transport and the Regions' Energy Efficiency Best Practice programme provides impartial, authoritative information on energy efficiency techniques and technologies in industry and buildings. This information is disseminated through publications, videos and software, together with seminars, workshops and other events. Publications within the Best Practice programme are shown opposite.

For further information on:

Buildings-related projects contact:
Enquiries Bureau

BRECSU
BRE
Garston, Watford WD25 9XX
Tel 01923 664258
Fax 01923 664787
E-mail brecsuenq@bre.co.uk

Industrial projects contact:
Energy Efficiency Enquiries Bureau

ETSU
Harwell, Oxfordshire
OX11 0RA
Tel 01235 436747
Fax 01235 433066
E-mail etsuenq@aeat.co.uk

Internet BRECSU – http://www.bre.co.uk/brecsu/
Internet ETSU – http://www.etsu.com/eebpp/home.htm

Energy Consumption Guides: compare energy use in specific processes, operations, plant and building types.

Good Practice: promotes proven energy efficient techniques through Guides and Case Studies.

New Practice: monitors first commercial applications of new energy efficiency measures.

Future Practice: reports on joint R&D ventures into new energy efficiency measures.

General Information: describes concepts and approaches yet to be fully established as good practice.

Fuel Efficiency Booklets: give detailed information on specific technologies and techniques.

Introduction to Energy Efficiency: helps new energy managers understand the use and costs of heating, lighting etc.